DOCUMENT RESUME

ED 458 090 SE 064 685

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TITLE Current Primary Science Practice: Observing What Actually Happens in the Classroom.
PUB DATE 1999-00-00
NOTE 8p.; Paper presented at the Annual Meeting of the Australian Association for Research in Education and the New Zealand Association for Research in Education (Melbourne, Australia, November 29-December 2, 1999).
PUB TYPE Reports - Research (143) -- Speeches/Meeting Papers (150)
EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Elementary Education; Foreign Countries; *Hands on Science; *Science Instruction; *Scientific Principles; *Teaching Methods
IDENTIFIERS *Australia

ABSTRACT

Very little has been published about the amount and nature science teaching in Australian primary schools and that which has is largely based on written surveys completed by teachers and principals at a sample of schools. This study was designed to follow these surveys into the classroom. I observed fourteen science lessons, interviewed twelve teachers and interviewed the science coordinators at eight schools in order to gain a more accurate picture of the teaching of science in primary schools. The structure and organization of science lessons was remarkably similar, as were the difficulties experienced by teachers trying to teach science. To improve students' experience of science in primary schools we need to find ways to better understand what is actually occurring in the classroom. (Author/YDS)

Current Primary Science Pracice: observing what actually happens in the classroom

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Paper presented at the AARE-NZARE Conference 1999, Melbourne,

29th Nov - 2nd Dec.

Very little has been published about the amount and nature science teaching in Australian primary schools and that which has is largely based on written surveys completed by teachers and principals at a sample of schools. This study was designed to follow these surveys into the classroom. I observed fourteen science lessons, interviewed twelve teachers and interviewed the science coordinators at eight schools in order to gain a more accurate picture of the teaching of science in primary schools. The structure and organisation of science lessons was remarkably similar as were the difficulties experienced by teachers trying to teach science. To improve students experience of science in primary schools we need to find ways to better understand what is actually occurring in the classroom.

Introduction

I am researching the role of practical activities in learning upper primary science and as such the subject of the amount and nature of science teaching in primary schools repeatedly arises in discussions with teachers and colleagues. Much of the research that has been done

(for example Adams, Doig, & Rosier, 1991; Australian Science, 1996; Board of Studies NSW, 1997; Lokan, Ford, & Greenwood, 1997)

suggests that a minimum of 1 hour of science is done each week. Anecdotal evidence and observational research such as Cousins (1996) suggest that in many schools effectively no science is taught and where it is taught it is often taught poorly. It seemed important to try and cast some light on this question and since I was interested in finding out what was going on from the students perspective it made sense to go and visit schools, sit in on lessons and talk to teachers.

It is difficult to gauge the amount and nature of primary science teaching because in primary schools because:

- science is often taught as an integrated unit with other subject areas and thus the proportion of science taught can vary from lesson to lesson;
- the one teacher is teaching many subjects and doing many activities with the children science is often taught incidentally at other times;

- the relative importance and teaching style of science varies widely between teachers;
- the normal routine is rarely normal and never routine (Cripps Clark, 1998); and
- surveys are often better at gauging intentions than actions.

Method

Eight schools were chosen so as to cover a wide variety of Australian primary schools, selected on the basis of personal contacts. Fourteen lessons were observed taught by twelve teachers.

Table 1: *Distribution of schools visited*

State		Location		Type		No. of students	
Victoria	3	Metropolitan	6	Government	5	>500	2
A.C.T.	3	Regional city	1	Catholic	2	500-150	3
N.S.W.	2	Rural	2	Independent	1	<150	3

Each school was visited for one day during which I:

- met with the science coordinator and discussed the science program in the school, collected a copy of any school policy and curriculum documents and looked at science resources and facilities;
- observed any science lessons or lessons which involve a component of science that were occurring that day; and
- interviewed the teachers the lessons observed.

Notes were taken during and immediately after the lessons and interviews.

Results

Who teaches science

In the eight schools that I observed science was either taught by the normal classroom teacher (six schools) or by a specialist teacher(two schools). In K-12 schools this could have been a specialist secondary science teachers but this was not the case in the two K-12 schools observed.

The two schools which did have a specialist science teacher were both small (just below and above 100 students) and the specialist science teacher gave time release for the classroom teachers. One science teacher was the most senior teacher in the school, after the principal, a primary teacher of almost twenty years experience who had written the science curriculum for the school and had a particular interest in science teaching. The other teacher had no science training or primary teaching experience and had been hired to teach LOTE, which was their area of expertise and, because the previous LOTE teacher had also taught science, they also taught LOTE and science. Both teachers felt restricted in undertaking prolonged or involved activities because of the lesson was timetabled for forty minutes to one hour at the same time each week.

Resources

Equipment was both an important concern and was surprisingly unproblematic. There was a universal support for using equipment, especially everyday equipment. It was the access to equipment and how quickly it can be obtained and used in the classroom that was the crucial issue to most teachers. "If I cannot put my hands on it straight away then I do not worry about it"- P1. Thus issues of purchasing, tidying and organising were dominant reflecting the time pressures that primary teachers see themselves as under. In one school this problem was ameliorated by spending one curriculum day constructing a set of kits each of which contained all the equipment to do a single science lesson.

This is consistent with the findings of the N.S.W. evaluation of the science and technology K-6 syllabus.

> However, the supply, storage and maintenance of everyday consumable materials such as batteries, corks, wire, bottle tops etc appears to be a major concern for schools and teachers. Many [teachers] find the process of collecting or locating bulk as consuming valuable time and energy. It is considered a constant that frustrates teachers and acts as a barrier. (Board of Studies NSW, 1997)

There was, however, little concern about what equipment to use and how to effectively use it. The pedagogical problems of using resources were generally glossed over with the mantra "hands on". Unlike secondary science laboratories where there is an elaborate initiation into a specialised relationship with equipment, in primary classrooms the equipment is regarded as an extension of everyday articles and so the issues involved tend to be restricted to those of safety. Thus science is integrated in the primary classroom not only in the sense that the lesson will skip from poetry to science to geography, but also in that the activities and equipment are seen as an continuous with those of craft and cooking and everyday life.

No particular concern was expressed about the level of resourcing and budgets. Teachers said they gave requests to coordinator who went out and bought what was necessary. Yet at two of the schools a lack of basic equipment, battery holders and magnets, impeded the lessons observed.

Lesson structure

There were remarkable similarities in lesson structure. Lessons were fairly uniform in structure: lasting about 50 minutes (between 45min and 60min), regardless of whether they were programmed, with a specialist teacher, or were taken by the classroom teacher who, in theory, had greater flexibility. Roughly one third of the time being used for each of the introduction, activity and conclusion (see Table 2, the lesson by lesson breakdown is shown in Appendix 1).

Table 2: *Average percentage of lesson devoted to various activities*

Activity	Percentage of lesson	
	All lessons	Practical activity lessons
Introduction		
Review	1	1
Procedural	12	13
Conceptual	17	18
Activity		
Practical activities	32	38
Free investigation	1	1
Watching a video	3	
Conclusion		
Procedural	5	4
Discussion & reporting	12	11
Recording	16	13

Practical activities formed the central third in all but two of the lessons observed. These two lessons used information gathering as the students central activity and were somewhat eccentric. One was given by a teacher who said he was having difficulty with discipline and was therefore not prepared to do a practical activity with the students and that the other was taken from 'Visual Ventures' unit the N.S.W. curriculum and was closer to a media studies lesson than traditional science.

A review of the previous lesson only occurred in two lessons for two and four minutes. All teachers spoke during the interview of the lesson observed being part of a sequence of lessons yet all but three of the lessons observed functioned autonomously with no overt or implicit reference to subsequent or previous lessons. The introduction generally included a long class discussion to which students contributed many of their own ideas. In fact the discussions were generally longer, and included more student input, before the activity rather than after it. This may be because the students are less responsive at the end of the lesson or students contributions to discussion are informed more by their general experience rather than their experiences in the practical activities or the teachers simply ran out of time. In nine of the lessons the students sat on the floor for the introduction and then returned to their desks for the activities and except for three lessons stayed at their desks for the conclusion of the lesson. In six of the lessons writing up and/or discussion of results was deferred to the next lesson

There was universal commitment from the teachers to using practical activities as an important part of lessons and three of the teachers explicitly said that they used "hands on" activities. This emphasis was illustrated by the complete absence of any teacher or student demonstrations in any of the lessons observed. Students appeared to enjoy the practical activities as epitomised by one boy during an optics activity saying loudly to no-one in particular: "Science is cool" (repeated twice). The teacher commented in the interview: "Students enjoy science and technology, especially the boys".

Teacher control

In all cases the questions and activities investigated were generated from the teacher. Students ideas were usually solicited in the initial discussion but were directed to the teachers agenda. The teacher dominated the classroom in the introduction and conclusion. It was in the practical activities that the students were able to exercise more autonomy. This was even more so in the activity where the students were rotating around stations. Here the teacher reasserted control by ensuring a very rapid movement

between stations.

During practical activities the teacher circulated between groups talking to individuals or groups of students. Occasionally the teacher would interrupt the practical activities to make an announcement to the whole class. There was an average of two announcements per practical activity and they were mostly of a procedural nature; for example "5, 4, 3, 2, 1. Try not to make it a banging motion, now continue" [when making permanent magnets]. Breaking the students into groups who did different activities led to longer periods of time spent on practical activities because the teacher had less time to talk or more precisely spread the talk between groups and consequently the amount each group received was less.

Discussion

As far as the one of the primary aims: to gauge the amount and nature of primary science teaching, this project has been a failure. It is difficult to randomly interrogate the amount or even the practice of science teaching in primary schools. You cannot for ethical and practical reasons, randomly visit schools, unannounced. Teachers naturally want to please and will preferentially teach science when they know you are visiting the school. The science taught and its manner of teaching will be affected by the observers presence. Nevertheless in order to improve the teaching of science in primary schools we need to start from a sound knowledge of current practice and so it behoves researchers to delve more deeply than surveys of teachers and principals.

As well as some obvious flaws there are many good features of primary science practice. We need to be very careful in our attempts to raise the standard of science teaching we do not reproduce the culture of secondary science teaching but rather nurture the best features of existing practice. To do this we need to better understand current primary science practice.

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Appendix 1: *Percentages of class time devoted to parts of lesson*

		S1	T1	T2	E1a	E1b	L1	H1	H2	H3	P1	F1	F2
Introduction	Review	0	0	2	0	0	0	11	0	0	0	0	0
	Procedural	22	4	8	14	8	9	20	31	4	7	17	9
	Conceptual	9	17	0	10	11	9	20	0	51	16	29	43
Activity	Practical activities	31	21	28	31	42	0	41	52	44	57	53	13
	Free investigation	0	13	0	0	0	0	0	0	0	0	0	0
	Watching a video	0	0	0	0	0	0	0	0	0	0	0	0
Conclusion	Procedural	4	4	11	17	0	21	0	10	0	4	0	0
	Discussion & reporting	9	42	17	12	19	21	7	6	0	2	0	13
	Recording	24	0	34	17	21	41	0	0	0	14	2	22
total time		54	48	53	42	55	34	44	48	45	56	59	55

Each capital letter refers to a different school. Numbers refer to teachers at each school and small letters to different classes taught by the same teacher. These timings and classifications are somewhat arbitrary. It was not always easy to differentiate between procedural and conceptual matters as teachers would rapidly slip between the two. That acknowledged there are some pretty unequivocal timings: the three major sections are clearly marked by the whole class discussion ending and students getting up from sitting at the front of the room and going to there own desks and working individually or in small groups.

Review	Discussion or teacher exposition which refers to previous classwork
Procedural	Giving instructions, explaining how to use equipment, allocating duties
Conceptual	Discussion or writing about the ideas and concepts involved in the lesson
Practical activities	Students doing activities individually or in small groups
free investigation	Children given time for undirected experiment and investigation
procedural	Tidying up and putting away
discussion & reporting	Reporting back to the class and class discussion
recording	Writing or drawing to record what they have done or discussed

Activity	**Percentage of lessson**	
	All lessons	**Practical activity lessons**
Review	**1**	**1**
Procedural	**12**	**13**
Conceptual	**17**	**18**
Practical activities	**32**	**38**
free investigation	**1**	**1**
Watching a video	**3**	
procedudural	**5**	**4**
discussion & reporting	**12**	**11**
recording	**16**	**13**

	Topic	Practical activity	Focus
S1	Communication	Making string telephones	Constructio
T1	Electric circuits	Constructing simple electrical circuits	Using activi
T2	Colour	Constructing glasses with coloured glasses	Motivation
E1a			
E1b			
L1			
H1	Human body		
H2			
H3			
P1	Magnetism	Electriciy	
F1			
F2			
A1a	Advertising	Watching a video, cutting out advertisments from magazines	Information
A1b		Making a wind powered winch	Constructio

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